

# Novel Design of Orifice Type Control Element for Mitigating Instabilities, Phase I

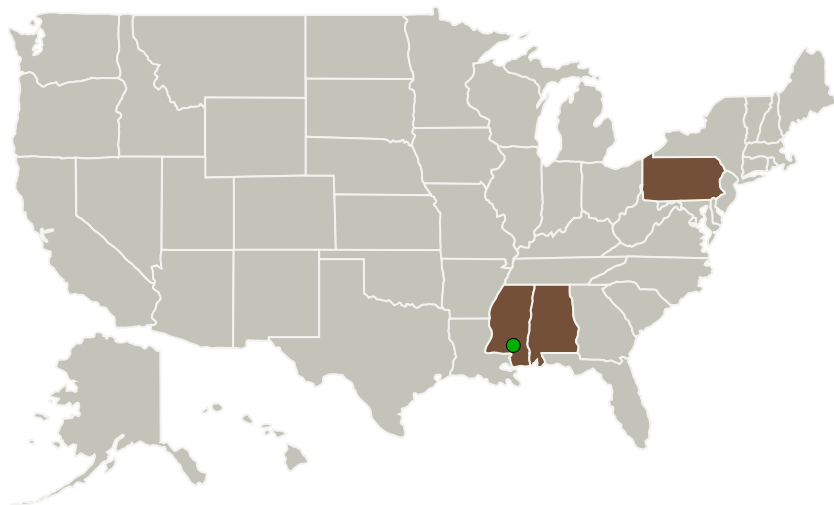
Completed Technology Project (2011 - 2012)



## Project Introduction

An orifice element is commonly used in liquid rocket engine test facilities either as a flow metering device, or to provide a large reduction in pressure over a very small distance in the piping system. While the orifice as a device is largely effective in stepping down pressure, it is also susceptible to a wake-vortex type instability that generates pressure fluctuations that propagate downstream and interact with other elements of the test facility resulting in structural vibrations. Furthermore in piping systems an unstable feedback loop can exist between the vortex shedding and acoustic perturbations from upstream components resulting in an amplification of the modes convecting downstream. Such was the case in the Ariane 5 strap-on P230 engine in a static firing test where pressure oscillations of 0.5% resulted in 5% thrust oscillations. The innovation described in this proposal directly relates to a proprietary design of a step down orifice that inhibits the instability modes generally associated with the operation of a traditional orifice while meeting performance guidelines. In the Phase I effort we will demonstrate the effectiveness of the new device through a combination of analysis and sub-scale testing in a cryogenic environment.

## Primary U.S. Work Locations and Key Partners



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## Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

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Organizations Performing Work	Role	Type	Location
CRAFT Tech - Combustion Research and Flow Technology	Lead Organization	Industry	Pipersville, Pennsylvania
Propulsion Research Center University of Alabama in Huntsville	Supporting Organization	Academia	Huntsville, Alabama
● Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi
University of Alabama in Huntsville(UAH)	Supporting Organization	Academia	Huntsville, Alabama

## Primary U.S. Work Locations

Alabama	Mississippi
Pennsylvania	

## Project Transitions

**February 2011:** Project Start

**February 2012:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140241>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

CRAFT Tech - Combustion Research and Flow Technology

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

Carlos Torrez

### Principal Investigator:

Vineet Ahuja

### Co-Investigator:

Vineet Ahuja

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## Technology Maturity (TRL)

Start: **2**  
Current: **3**  
Estimated End: **3**



## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.1 Chemical Space Propulsion
    - └ TX01.1.1 Integrated Systems and Ancillary Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System